

X.

Golden Rules
OF
Hygiene.

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GOLDEN RULES

OF

HYGIENE.

BY

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PREFACE.

IN the following pages an attempt has been made to present the reader with a few salient points that may prove of service to him in acquiring a practical knowledge of a subject that is daily increasing in extent and importance.

F. J. W.

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CONTENTS.

	PAGE
I.—AIR - - - - - -	7-23
VENTILATION - - - - -	- 13
WARMING - - - - -	- 20
II.—WATER - - - - -	23-39
GENERAL - - - - -	- 23
SOURCES OF WATER SUPPLY - -	- 25
DISTRIBUTION AND STORAGE - -	- 29
PURITY OF WATER - - - -	- 33
IMPURITIES - - - -	- 34
PURIFICATION OF WATER - -	- 38
III.—DISPOSAL OF REFUSE - -	39-58
(A,) STREETS - - - -	- 40
(B,) HOUSEHOLD - - - -	- 41
IV.—FOOD - - - - - -	58 67
MEAT - - - - -	- 58
MILK - - - - -	- 64
V.—INFECTIOUS DISEASES - -	67-69



Golden Rules of Hygiene.

I.—AIR.

Bear in mind the **percentage composition of pure air**, namely, 20·96 volumes of oxygen mixed mechanically with about 79 of nitrogen and ·04 of carbonic acid. There are also traces of ammonia, with watery vapour in large or small amount, according to temperature. Suspended solid matter or dust contains animal and mineral particles and bacteria. Ozone is sometimes present and points to extreme purity.

Remember that the **amount of oxygen varies** within slight limits. Pure sea air has 20·999 volumes per cent. : a

crowded London street, 20·96 ; a mine, perhaps 18·27 ; and a packed theatre, 20·65. Oxygen is mainly derived from plants which decompose carbonic acid in sunlight, absorbing the carbon and setting free oxygen ; it is lessened by the processes of respiration, combustion and putrefaction.

Note that the amount of **carbonic acid** in pure air is ·04 volumes per cent. Its permissible limit is usually fixed as ·06 per cent., a point often reached in the narrow streets and byeways of large towns. In crowded rooms it may rise to 3 or 5, or even more, volumes per cent.

Never forget that the carbonic acid is of value in estimating the impurity of air because it points to the accompanying **organic impurity** which does the harm. Carbonic acid gas by itself does not begin to be injurious until it reaches about 1·5 per cent. Thus, it does not injure the workers in aerated water manufactories.

The main sources of atmospheric impurity are respiration by man and lower animals; combustion of coal, gas, etc.; fermentation and putrefaction; various trade processes.

Bear in mind the effects of respiration on the composition of air. The oxygen is reduced thereby from 20·99 to about 16 per cent.; carbonic acid increased to about ·6; watery vapour is given off by the lungs to the extent of about 10 ounces in the twenty-four hours; and organic matter, the most harmful respiratory product, which is given off in minute quantities, most likely combined with the watery vapour.

Note that an adult male gives off per hour about ·6 cubic foot of carbonic acid, a small portion of which comes through the skin.

Note the important bearing of combustion upon the purity of air. Coal gives off carbonic acid with small quan-

tities of carbon monoxide (unless combustion be perfect), sulphurous and sulphuric acid, carbon bisulphide, sulphide of ammonium, sulphuretted hydrogen, water, sooty and tarry matters.

Observe that the **first great difference in the environment of towns and country** is that town air is laden with the products of combustion, chiefly sulphurous acid and soot, and with dust of special composition (*see p. 12*).

The combustion of purified coal gas gives off much the same products as that of coal, only that there is much less soot, tarry matter, ammonia and sulphur compounds. 1 cubic foot of gas consumes the oxygen of from 5 to 8 cubic feet of air, producing 2 cubic feet of carbonic acid and from .2 to .5 grains of sulphurous acid. Wood throws off little sulphurous acid when burnt. Oil and candles give off relatively much less carbonic acid and sulphurous acid than coal gas, but more organic matter.

Observe the effects of **coal combustion** in the destruction of plant life in towns, and of **coal gas** in the tarnishing of gilt picture frames and silver.

Note carefully that the **vitiating of the air** by putrefaction and decomposition is of a two-fold nature: (1,) *Chemical*, such as carbonic acid, sulphuretted hydrogen, carbon disulphide and many poisonous and mephitic gases; (2,) *Organic*, by living micro-organisms and their products (mainly distributed as dust)

Among the chief **trade pollutions of air** may be mentioned the dusty trades, especially steel grinding and working in hard stone; alkali works; offensive trades generally.

Always distinguish carefully between a **nuisance** that is merely an annoyance to the senses and one that is dangerous to health.

Never forget that **dust** plays an important part in air pollution, and must

be considered as including air-borne bacteria.

Street dust is made up chiefly of soot, débris pounded from the roadways and horse-dung. To the last-mentioned summer diarrhoea has been attributed. That disease is met with in towns where there is an enormous amount of horse traffic, but is practically absent in the country, where the road-dust is made up mainly of pounded stone and contains relatively little horse-dung.

Note the penetrating nature of dust. It finds its way into air-tight drawers, between the leaves of closed books, and into the interior of watches.

Bear in mind that **household dust** is made up of street dust together with soot and dust from fire and gas-lights, and a mass of cotton fibre, wool, epithelial cells and detritus of all possible kinds. It may contain innumerable species of moulds and bacteria, harmless and harmful.

VENTILATION.

GENERAL.

Remember that the **permissible limit of carbonic acid** is $\cdot 6$ volume per 1000, or $\cdot 06$ per cent. When that point is reached a room becomes "stuffy" and unwholesome.

The aim of ventilation is to keep the carbonic acid of a room at or below $\cdot 06$ per cent.

Never forget the reason why an average man requires 3,000 cubic feet of fresh air per hour. He himself gives off $\cdot 6$ cubic foot in that period of time, while the air already contains $\cdot 4$ per 1,000 cubic feet. 3,000 feet of fresh air in the hour will be found to reduce the $\cdot 6$ respired carbonic acid to the strength of $\cdot 6$ per 1,000 of the diluted standard. Put in another way, the man adds $\cdot 2$ carbonic acid to the already existing $\cdot 4$ per 1,000 in 3,000 cubic feet of fresh air. Or, knowing that the man gives off $\cdot 6$

cubic foot volume of carbonic acid, and that .2 is the addition allowable to bring up the existing .4 per 1,000 of fresh air to the .6 limit, then $\frac{.6}{.2} \times 1,000$, or 3,000 cubic feet fresh air.

Remember that under the ordinary atmospheric conditions of the United Kingdom the air of a room cannot be changed more than three times in twenty-four hours without causing too much draught. Therefore, to supply 3,000 cubic feet of fresh air there should be an air space of at least **1,000 cubic feet per head**.

Note that "no bedroom, however large, ever contains a sufficient supply of fresh air for the night, but the larger the room the more readily can efficient ventilation be contrived" (Whitelegge).

Never lose sight of the fact that cubic space allowed is not intended as a store of fresh air for breathing purposes, but as a reservoir, the contents of which

may be changed frequently without draught.

Make a note of the following **space allowances** which are made in practice :—

	Cubic feet per head.
Prisons - - - -	800
Barracks - - - -	600
Workhouses	} 300
Common lodging houses	
Canal boats - - -	60

Good hospitals usually allow 1,200 or 1,400 cubic feet space per patient with 100 superficial feet of floor and 8 feet of wall space.

Never forget that in a lofty room the **upper space is useless** in the absence of **ventilation**. In estimating cubic space under such circumstances no height above 12 feet should be taken into consideration. The lower air of a large hall with its floors crowded with sleepers might be grossly contaminated; in such a case a proper allowance of floor-space is all-important.

Note that 1,000 cubic feet per head is ample for horses and cattle, although in theory they want more fresh air than man owing to their greater lung capacity; yet in practice the allowance need not be greater inasmuch as freer ventilation is possible. The common allowance of 800 or even 600 cubic feet is not enough.

In estimating cubic space **deduct articles of furniture** and other objects that encroach upon the air space.

For convenience sake the whole subject of ventilation may be thus subdivided:—

(A,) *External* ventilation.

(B,) *Internal* ventilation — Natural or artificial.

Remember that **external ventilation** is all-important because it furnishes the supply of air for internal ventilation. The quality, quantity and circulation of external air, therefore, all demand attention.

Note the **essentials for external ventilation**: Wide roads, restricted height of buildings, space between houses and rows of houses, compulsory free space at back of buildings (should also be in front), abolition of courts and other well-like spaces surrounded by houses.

Nature's two great agencies for the purification of air, namely, **sunlight** and **wind**, are excluded by tall factories, tenement dwellings, mansions, hotels and other large buildings, as well as by the narrow streets and closely-packed courts and alleys of the slums.

Remember that the greatest sources of pollution of modern town air are **smoke** and **dust**.

Never forget that the chief agencies of natural ventilation are **wind** and **diffusion**.

Wind may blow right through a room, or may act by blowing across outlets

(*e.g.*, chimneys) and creating an exhaust draught.

Although a cowl may **prevent down-draught** in a chimney, it can **never create an up-draught**.

Bear in mind that inlets and outlets are **interchangeable** in almost any system of artificial ventilation.

Above all things take care that inlets are supplied with **pure air** (*e.g.*, it is no use taking air from the neighbourhood of a sewer ventilator, or from a passage vitiated with gas fumes and air from other rooms).

Note that inlets and outlets should be :
(*a.*) Open to inspection ; (*b.*) Capable of ready cleansing in all parts ; (*c.*) Simple in construction ; (*d.*) Beyond the control of inmates (especially in hospitals and other public institutions).

The direction of inlet air should be always upwards, and outlets are best placed near the top of a room.

Bear in mind that the best of all outlets is the chimney of an open fireplace with a fire burning.

It is specially important to **ventilate the staircases** of houses let in lodgings and common lodging houses. Windows should be inserted where necessary.

Condemn all back-to-back houses. The impossibility of through ventilation is definitely associated with diarrhoea, consumption and respiratory diseases generally.

Never forget that **consumption of the lungs** is definitely connected with bad house ventilation.

Bear in mind that the **simplest and cheapest contrivance** for ordinary windows is that of Hinckes Bird, consisting essentially of a block of wood a few inches deep fastened along the whole length of the window beneath the lower sash. This makes an upcast inlet between the two sashes.

The best inlet for large rooms and institutions is the **Tobin tube**, which admits air from the outside at the floor level through a perforated plate, and then passes the air up a vertical tube to a height of from 4 to 6 feet above the floor. Soot and dust can be excluded by a muslin filter.

Always see that the Tobin tube is (a,) open ; (b,) so arranged that it can be cleaned.

WARMING.

Remember the **essentials of open fire-place construction**, as laid down by Mr. Pridgin Teale :—

- 1.—As little iron as possible.
- 2.—The back and sides of the fire-place should be of brick or fire-brick.
- 3.—The fire-brick back should lean over the fire, not lean away from it.

-
- 4.—The bottom of the fire or grid should be deep from before backwards, probably not less than 9 inches for a small room, nor more than 11 inches for a large room.
 - 5.—The sides or “covings” of the fire-place should not be vertical, but inclined to one another as the sides of an equilateral triangle.
 - 6.—The “lean-over” at the back should be at an angle of 70 degrees.
 - 7.—The slits in the grating or grid should be narrow, perhaps $\frac{1}{4}$ inch for a sitting-room grate and good coal, $\frac{3}{8}$ inch for a kitchen grate and bad coal.
 - 8.—The front bars should be vertical, that ashes may not lodge and look untidy; narrow, perhaps $\frac{1}{4}$ inch in thickness, so as not

to obstruct heat ; and close together, perhaps $\frac{3}{4}$ inch apart, so as to prevent coal and cinder from falling on the hearth.

- 9.—There should be a rim $1\frac{1}{2}$ inches in depth round the lower insertion of the vertical bars.
- 10.—The chamber under the fire should be closed by a shield or “economizer.”
- 11.—Whenever a fire-place is constructed on these principles, it must be borne in mind that a greater body of heat is accumulated about the hearth than in ordinary fire-places. If there be the least doubt whether wooden beams may possibly run under the hearth-stone, then an ash-pan should be added with a double bottom, the space between the

two plates being filled with artificial asbestos, "slagwool," 2 inches in thickness.

- 12.—See that no woodwork comes within 10 or 12 inches of the back of the fire.

Remember that **cast-iron stoves** give off carbonic oxide. They should be lined with fireclay.

II.—WATER.

GENERAL.

Remember that water is a prime necessity of life, and that its plentiful and pure supply is essential to the public health.

The **quantity required** varies with the system of sewage disposal, local trades and other special circumstances. Thus Norwich has $14\frac{1}{2}$, London 35 to 40, and Glasgow 50 gallons per head daily. The smallest quantity permissible would

be 4 gallons, but that would not allow of bath and water-closet supply. A good allowance would be that given by Parkes :—

		Gallons per head daily.
HOUSEHOLD	Fluids as drink -	0·33
	Cooking - - -	0·75
	Personal ablution -	5·00
	Utensil and house washing - -	3·00
	Clothes washing (laundry) - -	3·00
	Water-closets - -	5·00
TRADE AND MANUFACTURING		- 5·00
MUNICIPAL	Cleansing streets	5·00
	Public baths and fountains -	
	Flushing and cleans- ing sewers -	
	Extinguishing fires	
<i>Total</i> -		<u>27·08</u>

Remember that our water supply comes ultimately from the clouds, which are masses of condensed atmospheric vapour.

In the United Kingdom the average annual rainfall is about 30 inches. It varies from some 20 inches on the east to 70 or more on the west coast and in Ireland.

SOURCES OF WATER SUPPLY.

Note that of the rain falling on the surface of the earth one part is evaporated, another collects in ponds or lakes or runs off in streams and rivers, while a third sinks into the ground to form subsoil water. Rainfall may also be stored in artificial lakes or reservoirs.

Subsoil water sinks until it meets an impervious layer of soil, and may be tapped anywhere above that point by a *surface well*. Beneath the impervious layer is another, and entirely distinct, collection of subsoil water which is reached by a *deep well*.

Further, subsoil water issues forth in the shape of springs. Those portions above and below the impervious stratum

form *surface* and *deep springs* respectively.

Remember that **rainwater**, besides being flat and insipid, has great solvent powers. It should, therefore, **never** be **stored in lead, zinc, iron, or galvanized iron cisterns**, or be conducted through lead pipes; nor should it be used after collection from a lead roof.

The water of streams and rivers may be **contaminated** by passage through artificially-manured lands or by sewage pollution.

Regard with suspicion any river water that has been once contaminated by sewage. It is doubtful whether such a water, from a bacteriological point of view, ever becomes safe again for drinking purposes under natural conditions.

The water of surface springs and streams is moderately hard, that of rivers is harder, and that of deep springs and deep wells hardest of all.

Remember that the **hardness** of **water** is due to carbonate of lime and other salts in solution. Its presence imposes a severe tax upon consumers, because it wastes a certain amount of soap that is required to saponify all the lime and magnesia present before a lather can be formed.

Bear in mind, then, that **soft water** (rain) is best suited for washing purposes.

Hardness is temporary or permanent. *Temporary* : Due to chalk, which is deposited by boiling (this expels the carbonic acid that holds the chalk in solution). *Permanent* : Due to chloride and sulphate of lime, and salts of magnesia, which are not deposited on boiling.

Hardness is measured by degrees. It takes about 8 grains of soap to precipitate 1 grain of chalk, which is taken as the degree in a gallon of water. Rain-water is usually less than half a degree in hardness.

Regard all shallow surface wells especially if near houses, stables or cultivated ground, with the greatest suspicion.

Instantly condemn all shallow wells in towns and, generally, in the midst of any collection of houses.

Always regard surface springs with suspicion, and deep springs also unless far from any possible contamination.

Remember that **deep wells may be polluted** by leakage into the bore above the level of the impermeable strata. They should be built of bricks set in cement so as to be absolutely impervious, at any rate, down to the impervious layer. The wall should be carried above the surface and its mouth sealed with stone slabs. A pump should always be used, as the old-fashioned windlass and bucket invite pollution.

Always be mindful of the fact that **soft water dissolves lead** because of the absence of the protecting coat of

lime salts deposited by hard water. This solvent power is especially marked in upland surface water collected from moors.

Note for reference the broad characteristics of water drawn up in the following summary from the Rivers Pollution Commissioners :—

WHOLESOME	{	1 Spring water	}	Very palatable
		2 Deep well water		
	SUSPICIOUS	{	3 Upland surface water	}
4 Stored rain-water				
DANGEROUS		{	5 Surface water from cultivated land	}
	6 River water to which sewage gains access			
		{	7 Shallow well water	}

DISTRIBUTION AND STORAGE.

Remember that in public water supplies the **constant** is always better than the **intermittent** service.

Note the chief *advantages of the constant system*: Water always available; no need for cisterns except during temporary failure of supply; plenty of water for extinguishing fires. *Disadvantage*: Waste from imperfect mains, pipes and fittings.

Note the *advantages of the intermittent system*: It husbands supply and saves pockets of the water companies. *Disadvantages*: Necessitates cisterns; pipes when empty are in a state of vacuum, which may draw in foul air and sewage contamination; absence of water for a great portion of the twenty-four hours; insufficiency in case of fires.

Remember that a **main pipe** should be laid at least 3 feet below the surface. Otherwise it is apt to be cracked by the frost and lead to great waste and to danger of pollution. Main pipes are usually made of iron; the Barff and other processes protect them from rust.

House pipes are usually made of lead, which, however, is dangerous with soft waters. Galvanized iron pipes should be used wherever possible.

Always protect from frost water pipes that are exposed to the outside air.

Bear in mind that cisterns are absolutely necessary with an intermittent supply. Nevertheless, cisterns are a standing **source of danger** as regards the pollution of water.

The **house storage** of water requires a cistern, which should be placed in such a position that it can be readily inspected and cleansed, and the access of dust, foul air and living creatures be excluded. Parkes gives the following points: (a,) The cistern should be of stoneware, slate or galvanized iron; (b,) It should be placed in a light and well-ventilated position, and should be properly covered; (c,) It must not be used to flush water-closets, but may supply the "intercepting," or waste-preventing cisterns, which

should be used for this purpose; (d,) The overflow pipe must be carried out into the open air to terminate as a warning pipe; it may end over the open head of a rainwater pipe if the cistern is in an upper storey, or over a trapped syphon gulley when the cistern is near the ground; (e,) The cistern should be cleaned out at regular intervals.

Always examine the water supply in epidemics of enteric fever or cholera, as those are the two chief water-borne diseases. Dysentery, diarrhoea, dyspepsia, yellow fever and other maladies have been traced to water. Various intestinal worms and blood parasites, such as *Filaria sanguinis hominis* (guinea-worm), are communicated to man through the same agency.

Bear in mind that water may be contaminated by lead, copper, zinc, mercury or arsenic derived either from source of origin (e.g., a disused mine turned into a well) or from some point

of the distributing system of pipes and reservoirs.

PURITY OF WATER.

Never forget that the clearest, most sparkling and palatable water may be charged with deadly metallic and bacterial poisons.

In **collecting water for analysis** use a Winchester quart bottle, which must be scrupulously clean. It should be rinsed out twice with the water to be analysed, and the stopper tied down with a leather cap but not sealed; (the string may be sealed).

Always write down full details at the time of collection and send them to the analyst, who has often to depend upon a careful consideration of *all* the facts of the case. Note the following particulars:—

1.—Date.

2.—If from well, stream, town supply or other source.

- 3.—If from well, depth (approximately), covering, etc.
- 4.—Distance of nearest midden, drain or cesspool.
- 5.—If near stable or farm yard.
- 6.—Any other source of pollution.
- 7.—Is water from pump or tap?
- 8.—If from a pump, state nature of latter—wood, iron, etc.
- 9.—If from tap, are pipes of lead, iron, or are they galvanized or otherwise specially protected?
- 10.—What is special reason (sickness, etc.) for requiring analysis?
- 11.—Any other particulars to which it is desirable to call attention.
(REID).

IMPURITIES.

Remember that lead may cause poisoning when present in so small a quantity as $\frac{1}{10}$ grain to the gallon. Zinc, copper or arsenic may also be present.

Note that **sewage pollution** may be proved in three ways :—

(A,) By the *Microscope*.

(B,) By *Chemical tests*.

(C,) By *Bacteriological examination*.

(A,) **The microscope** may show that water has been polluted by sewage and house refuse by demonstrating fibres of cotton or linen, human hairs, epithelial cells, starch, striped muscular fibres, the ova of tapeworms and other objects. The sewage fungus (*Beggiatoa alba*) occurs in sewage-polluted water in the form of branching, colourless threads.

(B,) **The chemical substances** that point to sewage contamination, although not of themselves hurtful, show the possibility of access of disease-producing bacteria. The most important are :—

(a,) *Total solid* residue after evaporation in pure water may reach 100 parts per million ; in impure water 700 or more. This point is valuable taken with other impurities.

(b,) *Chlorides* may reach 100 per million in pure water. When present in large amount together with excessive total solids and nitrates, or nitrites, it points to sewage pollution (urine).

(c,) *Nitrates and nitrites* represent "oxidised" or "nitric" nitrogen. Pure water may have a trace of nitrate but is free from nitrite. Nitrites point to more recent and dangerous pollution and are readily oxidised into nitrates. Nitrates may occur in deep well water and may be disregarded if only a small quantity of organic matter be present.

(d,) *Organic (or oxidisable) matter* is estimated by the amount of ammonia and albuminoid ammonia present, as it bears a constant ratio to those substances. "Absence of any trace of albuminoid ammonia is suggestive of organic purity, even if free ammonia and chlorides are high. Albuminoid ammonia less than .05 per million is consistent with extreme purity; and if free ammonia is

absent or scanty, albuminoid ammonia under $\cdot 10$ is no evidence of impurity. If, however, there is much free ammonia, $\cdot 05$ albuminoid ammonia is suspicious, and $\cdot 10$ is strong evidence of pollution; $\cdot 15$ or more should condemn a water absolutely. In good waters the free ammonia usually ranges from $\cdot 00$ to $\cdot 01$ to $\cdot 03$ per million, and rarely exceeds $\cdot 05$ ” (Whitelegge).

(C,) **The bacteriological examination** of water is nowadays often the most important. By this method of analysis direct evidence may be obtained of the presence of bacillus coli communis or other bowel organisms, b. typhosus, b. cholerae and other disease-producing bacteria.

Be most careful in collecting a sample for bacteriological examination to use a thoroughly **sterilised bottle** (one ounce size is large enough), and do not fasten the stopper with sealing wax. If sent any distance to the laboratory, it should be packed in a special ice-box (Pakes’).

PURIFICATION OF WATER.

A.—GENERAL.

Remember that **sand filters** on a large scale act not only mechanically but also biologically by means of the layer of micro-organisms that grows over their surface. If this be damaged by frost or other agency the passage of harmful matter becomes possible.

Note that the biological and chemical tests of any public service should be **performed daily**.

B.—DOMESTIC.

Never lose sight of the fact that ordinary filters, which fail to exclude micro-organisms, are **a snare and a delusion**. They actually increase the number of micro-organisms in the filtrate, as the filtering medium forms a culture bed for the growth of bacteria.

Always adopt a filter of the Pasteur-Chamberland or Berkefeld type. The water is filtered, preferably by pressure, through thin unglazed porcelain which

does not permit the passage of bacteria. A convenient form has a hollow porcelain "candle" so made that it can be fastened to an ordinary tap.

Remember that the "candle" can be cleaned by boiling. After a time, however, the filter can be effectually cleaned only by firing, as the porcelain becomes choked.

Bacteria-free water can be obtained by these biological filters. In the French army their use has led to a great reduction of typhoid.

Do not overlook the fact that boiling, while it destroys the germs of disease in water, does not get rid of lead and some other chemical impurities.

III.—DISPOSAL OF REFUSE.

Scavenging :—

A.—Street.

B.—Household: (I,) Ashes, etc.;
(II,) Excreta

A.—STREETS.

Note the importance of **systematic cleansing** of streets, roads, footways, courts and alleys in towns. Dust from such places contains a large amount of organic matter and myriads of bacteria from horse droppings.

Bear in mind that the best paving of roads and footways is hard, impermeable and smooth.

By far the best way of cleansing streets, as well as courts and alleys, is to flush them with hose and hydrant attached to the water mains.

[The Public Health (London) Act provides as to scavenging: The sanitary authority must cleanse streets, footpaths, cesspits, earth-closets, privies and cesspools. They must remove house-refuse at proper intervals, and trade refuse; also, if required to do so, on payment, they may undertake the collection of manure and other refuse on

request, or may, by order, require periodical removal by the owner.]

B.—HOUSEHOLD.

I.—ASHES, ETC. (DRY).

Remember that the **ash-bin** should be non-absorbent and tightly covered.

Galvanized boxes are better than a fixed bin because they can be more readily and completely emptied.

Always mistrust the “**dust-shoot**” often found in mansions and other collections of flats and small tenements built on the block system. They cannot be cleaned, and they admit foul air and dust into the dwellings. The large receptacle at the foot of the shoot is liable to become a nuisance. All flats should have separate galvanized pails.

Do not forget that the **objectionable portion** of the “dry” house-refuse consists of vegetables, scraps of food and other organic matter that find their way into the bins.

The readiest and, from the householder's point of view, the most economical way of getting rid of much of this organic matter is to **throw it upon the kitchen fire.**

Always insist that the **dust cart** be furnished with **a proper cover**, and note that daily removal of dust is always desirable.

Note that the proper way of disposing of household dust is to **burn it** in a destructor. The contained coal, cinders and other combustible stuff furnishes plenty of fuel. The resulting clinker can be sold, and the heat developed in the furnace can be utilized in generating power for pumping, electric supply, and so on.

Never sanction the old-fashioned method of depositing dry town refuse on a "**dust-shoot.**" The waste land thus converted into a muck heap will almost certainly be used for building purposes

at some time or other if in the neighbourhood of a town.

II.—EXCRETA.

(a,) *Conservancy system.*

(b,) *Water carriage system.*

A.—CONSERVANCY OR DRY SYSTEM.

The best dry system is the **earth-closet**. It is well fitted for the country, where there is no difficulty in getting plenty of dry earth and of disposing of the soil as a manure.

Bear in mind that for towns the dry system is inferior to the wet on the score of cost, convenience, wholesomeness and efficiency.

Do not countenance the privy ashpit or midden in any town.

The **pail system**, with frequent and regular removal, is the only dry method permissible on a large scale in towns.

B.—WATER CARRIAGE SYSTEM OF HOUSE DRAINAGE.

Never be satisfied in inspecting any

system of drainage without seeing for yourself the actual condition of every part—closet pans, water flush, traps, pipes, ventilators, inspection and disconnecting chambers ; see everything.

Always **mistrust** the closet and drainage construction of the builder and the jack-of-all trades who has not had a proper sanitary training. The greater his reputation for cleverness, as a rule, the worse his work.

Keep clearly in sight the fact that this **want of sanitary knowledge** may apply to plumbers and builders as well as to self-satisfied amateurs. Builders' drains are often full of glaring faults.

Remember that the closet and drainage of every new house **should be passed by experts** before anyone is allowed to live therein. It is not altogether uncommon for drain pipes to be unconnected with the sewers, so that the sewage passes into the basement

until the defect is found out, perhaps years later.

Never forget **the cardinal features of modern house drainage**, namely, that every part of the system should be either in full view or so constructed as to be open to inspection.

WATER CLOSETS.

Always condemn the old-fashioned pan closet with its dangerous D-trap.

Remember that the best modern closets dispense with all woodwork and fittings that are not absolutely necessary.

Note that the best material for the pan is **glazed earthenware**, and that the pan and trap can be made advantageously in one piece.

The "valve" closet is apt to get fouled beneath the valve and to get obstructed in the overflow pipe between pan and valve-box. The "**wash-out**" closet gets readily fouled. Both these closets require a large flush of water,

especially the former; the 2 or $2\frac{1}{2}$ gallons flush of the ordinary water-waste preventer is not enough.

Perhaps **one of the best water-closets is the "wash-down"** (a modified short hopper), fitted with a flushing rim and a water-waste preventer.

Always ascertain where there is an overflow from pan: (a,) That it is *not obstructed*; (b,) That it is *trapped with an S-bend*; (c,) That the bend *opens into the valve-box* so as to be protected by the valve when dropped; (d,) That a small branch extends from the supply pipe to the overflow so that the water in latter is *constantly renewed* (otherwise it is apt to be emptied by siphonage).

Always see that the flushing water is not taken directly from a drinking water cistern.

Note the following points about the **water-waste preventing cistern**: (a,) It economises water; (b,) It breaks the

connection between the water cistern and the water-closet basin ; (c,) Where there is no cistern it prevents backward contamination of the water mains through the supply pipe (formerly a common source of pollution) ; (d,) When provided with a sufficient "head," *i.e.*, 4 feet above the basin, a good flush is secured.

Always see that where a "safe-tray" is provided to catch the splashing from a bath or a water-closet, its exit pipe is **not carried into the soil-pipe**, but straight through the wall into the outer air.

Note that a **water-closet** should always be placed against an **outer wall** so that the soil-pipe can be carried at once to the outside of the house.

See that the ventilator for the soil-pipe is attached to the **highest point outside the house**. The best way is to make it a continuation of the soil-pipe clear of the roof. It should be equal in

size to the soil-pipe ; its opening should be away from gutters, windows, chimneys and water cisterns, and should be protected from access by birds.

Remember that **soil-pipes and drains** should be as **free as possible from bends** in their course. There is no need for a trap at the foot of the soil-pipe.

Always bear in mind that where a soil-pipe is common to several water-closets one above the other, it is necessary to **provide an anti-siphon ventilator** communicating with the highest point of the closet trap, otherwise there is a danger of the trap being emptied by siphonage.

Never lose sight of the fact that the **main dangers from house drains** are due to the entry of sewer gas and to the contamination of water supplies. The first is obviated by: (a,) Ventilation of soil-pipes and of sewers ; (b,) By properly constructed closets ; (c,) By keeping all

drains outside the house; and (*d*,) By disconnecting from the drains all waste pipes from baths, sinks and lavatories. The second by : (*a*,) Proper protection of cisterns; (*b*,) By disconnecting water supply from closets; and (*c*,) By taking the cistern waste-pipe straight into the open air.

Do not sanction the carrying of **drain pipes under a house**. If for structural reasons that course cannot be avoided, see that the pipes are laid in 6 inches of solid concrete all round, or else that they are cased in concrete and carried upon a floor within reach of observation.

Instantly **condemn any gulley or grating** in a cellar or basement to carry off slop-water to a drain.

Remember that in low-lying districts where there is backward pressure in the main sewers, **sewage may be forced back into basements**. In such cases the drains should be strong and water-

tight for some distance above the sewer level.

The best material for soil-pipes is rolled lead; iron (coated by Barff's process) may be substituted outside houses, but great attention must be paid to joints.

Never sanction the use of a rainwater pipe from the roof to ventilate a soil-pipe.

The best house drains are made of **glazed stoneware** with cemented joints. They should preferably be laid in concrete, and where the soil is soft that precaution will be absolutely necessary.

Bear in mind that **a 4-inch drain is ample** for small and medium houses, and a 6-inch for large houses. *The smaller the drain, as a general rule, the more effectual the flushing and automatic cleansing.*

Observe that **the gradient** of a 4-inch drain should be 1 in 40, of a 6-inch drain 1 in 60, and of a 9-inch drain 1 in 90;

this will give in each case a velocity of flow of between 3 and 4 feet per second (Kenwood).

Never allow one drain to enter another at a right, but always at an acute, angle. Observe the same rule in the junction of drains with sewers.

Bear in mind the technical **definition of a sewer**, namely, a drain receiving the drainage of two or more buildings. Generally speaking, the care of sewers is vested in the local sanitary authority, and that of drains in the owner. An exception is where a combined drain has been laid down for two or more houses under the sanction of the local authority and an official record has been kept, in which case the owner is responsible.

See that the house drain is properly **disconnected and ventilated before entering the sewer**. This can be best done by an inspection chamber placed at the junction of the main and branch drains, furnished with : (a,) A ventilator

(inlet or outlet); (b,) A trap on the sewer side; (c,) A raking arm that can be opened to cleanse the sewer.

The **manhole chamber** is simply the foregoing on a larger scale. It should be placed at a distance from houses and built with impervious walls.

Always insist upon the necessity of **testing house drains** for leaks after they are laid and before they are covered in.

The **chief drain tests** are: (a,) The *water test*, by stopping the lower end of the drain with an expanding indiarubber rimmed plug and then filling with water; (b,) The *smoke test*, in which smoke is sent into the drain by a forcing apparatus; (c,) The *peppermint test*, by pouring half an ounce of oil of peppermint down the highest water-closet and washing down with several gallons of hot water.

All **rainwater pipes and waste pipes** from sinks, baths and overflows **should**

be disconnected from the drains by opening over a properly constructed gulley trap. Further, every waste and overflow pipe inside a house should be provided with an **S-shaped** trap, having a screw-cap at the lowest point so as to permit of cleansing away grease, soap, and so on.

Remember that the **overflow of a cistern** should be carried **straight out into the air** wherever possible, so that it may act as a "warning pipe" and show that the water supply is not controlled by the ball-valve.

Remember that **all bends** in drains should be made with a *specialty-curved drain pipe*. **All junctions** between different drains should be made by *special junction pipes*, or better, by a common inspection trap.

Note that the socket end of the drain pipe should point *against* the current of the sewage. Masons often put it the reverse way.

Do not forget that all earthenware pipes **should be tested before use** and their quality certified by a recognised mark.

Bear in mind a small pipe should join a larger only **through a diminishing drain pipe**. Masons are fond of joining them by slipping the socket of a larger pipe over the socket of the smaller, thereby reversing the proper order of laying on the smaller-piped side of the junction.

Instantly **condemn** the old-fashioned **brick drain**. It is sure to leak sooner or later and to be riddled with rat-holes. (The bricks are often set in mortar which crumbles away.)

Note that **the gradient** of a 4-inch drain should, if possible, be not less than 1 in 40, a 6-inch 1 in 60, and a 9-inch 1 in 90 (4-40, 6-60, 9-90).

When the fall of a drain is **insufficient** it may sometimes be remedied by

a flushing tank that is worked automatically by the slop-water from baths, sinks and so on.

Always bear in mind that **rat-holes** act as so many inlets of sewer gas into a house.

Note that **drains may become choked** mainly because they are: (a,) Leaky (solids collect); (b,) Too large (insufficient flush); (c,) Insufficient fall; (d,) The outlet of disconnecting trap higher than inlet (a common fault).

SEWERS.

Remember that the sewers of a town have to provide for rainfall (storm-water) as well as the removal of sewage.

Bear in mind that formerly the **leaky sewers** drained off subsoil water, but at the same time they polluted ground air and ground water, and in that way contaminated houses and poisoned wells.

Observe that the **aim of modern sewers** is to be watertight.

Note the *combined* system, which receives both surface rainwater and sewage ; and the *separate* system, which takes off sewage apart from surface and subsoil waters.

Remember that the **combined system** has to provide for overflow in periods of rain, otherwise the sewers become full, and cellars and basements are flooded in low-lying districts. (In London this is done by intercepting sewers that overflow into the Thames.)

Much **smaller drains** are needed for the sewage proper. At the same time the cost is great, as double sets of pipes are needed for houses and for main drains. (Builders are apt to connect rainwater pipes to the sewage system and *vice-versâ*.)

Remember that a modern system of sewerage should have a **man-hole** at every point of change in direction.

Sewers up to 18 inches internal diameter **are best circular**, and construction of stoneware or iron, with patent joints to stoneware pipes in damp soil.

No public sewer should be less than **9 inches in diameter** (Latham).

For **sewers over 18 inches** diameter and up to the large outfall sewers the best form is **the egg-shaped** in section with the small end uppermost. They should be made of hard impermeable or glazed bricks set in cement and specially moulded for the smaller sewers.

The **large outfall sewers** should be circular in shape.

Under no circumstances should sewage be conveyed direct into a stream, river or lake.

Where the outfall sewers open into the sea the outlet should be protected by **a tide-valve**, and should always be placed **below low water level**.

Remember that although the Rivers Pollution Prevention Act is a dead letter in many parts of the country, it, nevertheless, makes it **illegal to discharge sewage into a stream**. The definition of "stream" is so elastic that it includes rivers, streams, canals, lakes and water-courses other than watercourses used mainly as sewers; and also the sea to such extent, and tidal waters to such point as may, after local inquiry and on sanitary grounds, be determined by the Local Government Board.

Bear in mind that although the organic matter of sewage is oxidized when discharged into a large quantity of fresh running water, there is, on the other hand, no evidence of the destruction of disease-producing bacteria.

IV.—FOOD.

MEAT.

Note the characters of **good meat**, which should be firm and elastic to the

touch, deep red, marbled with pale, yellowish fat. **Bad meat** is light in colour, moist, flabby and bluish, afterwards becoming green. The odour of putrefaction is distinctive; if slight it may be detected by plunging a knife into the flesh up to the hilt and then holding the blade to the nose; or by puncture with a skewer; or a small quantity may be chopped up and put in hot water.

Remember that the flesh of *young animals* is naturally pale, and may in that particular resemble that of older animals that have suffered from exhausting diseases.

Remember that bladder-worms (*Cysticercus cellulosæ*) vary in size from a minute dot to a cherry or larger, but may be distinguishable only under the microscope. They are most common in young pigs and calves and are the intermediate stage of the tape-worm in man.

The beef tape-worm (*Tænia medio-canellata*) has no hooklets in the head, whereas *Tænia solium* (the pork tape-worm) has a fringe of hooklets in that position.

Remember that the **microscope** is needed to detect *Trichinæ* in pork.

Note.—There is nothing in the naked eye appearance of the flesh to suggest the presence of *Trichinosis*. The disease, common in German and American pigs, is fortunately rare in the United Kingdom. In Berlin the carcase of every pig is tested by the microscopical examination of muscle taken from six different parts of the body. When trichinosis occurs in man in the United Kingdom it is usually due to eating uncooked German or American sausages.

Always **carefully examine** the lungs, liver, spleen and lymphatic glands for evidence of tubercle, actinomycosis, inflammations and parasites.

Note that if the flesh of a beast under examination be pale, moist, flabby and lacking in fat, these facts alone should be sufficient to condemn the carcase. In the absence of any self-evident cause, such as tubercle, it will be wiser to use the microscope.

Bear in mind that **freezing does not destroy micro-organisms**, nor presumably the cysticerci and other encysted parasites.

Remember also that although **thorough cooking** (especially boiling) destroys parasitic worms and bacteria, yet in practice the temperature of the interior of a joint is often not raised sufficiently high to destroy these forms of infection. Neither does cooking destroy the products of putrefaction that may have tainted the meat before it was cooked. (*Example*.—An infected knife may have contaminated the interior of rolled beef.)

In cases of **mild tuberculosis** where the tubercle is confined to certain organs and glands it is generally held that the rest of the carcase may be used for food. At the same time it should be noted that in the process of slaughtering all parts are probably contaminated by tuberculous material.

Remember the principles laid down by the Royal Commission upon tuberculosis:—

1.—That the **entire carcase and organs be condemned** when: (a,) There is miliary tuberculosis of both lungs; (b,) When tubercle is present on pleura or peritoneum; (c,) When tubercle is in muscles or in lymphatic glands of muscular parts; (d,) When tubercle is found *anywhere* along with an emaciated carcase.

2.—That the carcase, if otherwise healthy, be not condemned, **but tuberculous parts seized** when: (a,) The lesions are confined to lungs and thoracic

lymphatic glands ; (b,) Confined to liver ; (c,) Confined to pharyngeal lymphatic glands ; (d,) When confined to any combination of the foregoing but collectively small in extent.

3.—**The whole carcass** and organs of a pig should be seized if tubercle be found in any part.

4.—In the case of foreign dead meat **the whole carcass** should be condemned if the pleura have been “stripped.”

Bear in mind that **horseflesh is darker and coarser** than beef and has a peculiar smell. Its fat is soft and more yellow than that of the ox. The bones differ in shape, and the muscular attachments are more strongly marked. The horse's tongue is broad and rounded at the end instead of pointed as in the ox ; and the hyoid bone is made up of five parts instead of the nine present in the ox. The horse's liver has three large and distinct lobes and a fourth small one, whereas that of both ox and

sheep consist of one very large and another relatively small lobe (Parkes & Kenwood). The horse's liver has no gall-bladder.

Bear in mind the practical point that **dogs should be excluded from slaughter-houses**. By eating diseased organs they become infected with various maladies. They are also apt to distribute the ova of the dog tape-worm which may, by the agency of meat, be conveyed to man, into whose tissues they penetrate and develop into the intermediate bladder stage of echinococcus or hydatid cyst.

MILK.

Remember that **milk is exposed to various risks** of contamination from the time it leaves the udder of the cow until it reaches the consumer. Thus the cow may be diseased, the milker or the distributing milkman may be infected, dirty cans may be used by milkers, distributors

or consumers, polluted water may reach the milk in washing vessels or as an adulteration, specific disease germs may lodge in the milk from infected individuals at farm, collecting or distributing dairy or house of consumer. In urban milk shops and dairies there is constant exposure to town dust charged with bacteria, many of which come from the intestine of the horse.

Note that the **commonest epidemic diseases due to milk** are enteric fever, scarlet fever and diphtheria. Summer diarrhoea is probably due to a large extent to the infection of town milk by bacteria conveyed in the form of dust. Tuberculosis is no doubt spread by the milk of tuberculous cows, especially in the case of children. Foot and mouth disease is commonly communicated by the milk of infected cows. Other diseases may probably be communicated in a similar manner, even where the udder is unaffected.

Always impress on the community the fact that *boiling sterilises milk*.

Note, however, that **boiling does not destroy the products of fermentation and putrefaction** when the milk has once undergone lactic acid fermentation and putrefactive processes. Under such circumstances the milk contains various substances that act as more or less violent gastric-enteric irritants.

Bear in mind that while boiling impairs the flavour of milk a similar objection does not apply to "**pasteurisation**," by which process the milk is sterilised by exposing it to a temperature of about 170° F. for a quarter of an hour or twenty minutes.

Remember that a **milk epidemic** is *sudden* in its appearance. The cases can be traced to a particular dairy or milk vendor. Attacks outside the infected round are often due to the fact that the milkmen are in the habit of furnishing

each other with small quantities of milk. Households supplied with the infected milk escape when it is the rule to boil all milk.

V.—INFECTIOUS DISEASES.

The communicable diseases now compulsorily notifiable throughout the United Kingdom are:—

SMALL-POX	DIPHTHERIA
CHOLERA	MEMBRANOUS CROUP
ERYSIPELAS	SCARLET FEVER
TYPHUS	ENTERIC OR TY-
RELAPSING FEVER	PHOID FEVER
PUERPERAL FEVER	CONTINUED FEVER

Remember that, with the sanction of the Local Government Board, any sanitary authority may include *any other infectious disease*.

The chief infectious diseases **not compulsorily notifiable** are:—

MEASLES	RÖTHELN
WHOOPING COUGH	EPIDEMIC OR SUM-
TUBERCULOSIS	MER DIARRHŒA
CONTAGIOUS OPH-	CHICKEN-POX
THALMIA	VENEREAL DISEASES
RHEUMATIC FEVER	MUMPS
PNEUMONIA	

Remember that the prevention of infectious diseases rests upon the tripod of **notification, isolation and disinfection.**

The **duty of the inspector** is to investigate the cause of the attack and surroundings of the patient, but *not to examine the patient* or express any opinion as to the nature of the malady.

Remember that **bacteriological tests** will readily determine the diagnosis in nearly all cases of doubtful diphtheria, enteric fever and phthisis of the lungs.

Always bear in mind the **possibility of typhus**. (This disease has become extremely rare in the United Kingdom, so that it may be overlooked by the present generation of practitioners.)

Bear in mind that it is almost hopeless to endeavour to control any highly infectious disease (*e.g.*, typhus and small-pox) without the aid of a **special house for the reception of persons** who have been exposed to infection.

Do not neglect to make a full list of **all articles** removed for disinfection. Note at the same time any damage to same, such as stains, rents, patches, and so on.

Remember that **leather articles and furs** should not be placed in a steam disinfecter.



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